



ANNOUNCEMENTS

The dust has settled and (nearly) all the boxes are unpacked from the Aeronomy Lab's move into the David Skaggs Research Center. For the first time, the Aeronomy Lab's researchers are together in one facility. Many at the Aeronomy Lab have helped us to realize that goal. **Tom Van Zandt** served as our representative on the Boulder Building Committee over the last decade-plus. He deserves credit for overseeing many of the scientific and engineering design achievements that culminated in our state-of-the-art research building. Many, many thanks go to our Aeronomy Lab move coordinators, **Carl Howard** and **Roger Jakoubek**, for their creative, patient, skilled, and positively enthusiastic approach to the challenge. The **Computing and Networking Resources Group** did a phenomenal job of making the computing move nearly seamless (what move?). **Dan Albritton** was chair of the Tenant Directors' Board during the period prior to the move and will continue in that role during this "settling in" period. And the crew

at AA American Moving and Storage, Inc., was top-notch. Kudos, all around.



Three reports have recently been printed and are available through the Lab Director's Office: • The World Meteorological Organization/United Nations Environment Programme document *Scientific Assessment of Ozone Depletion: 1998* and its separately published Executive Summary, prepared for the Montreal Protocol, give the latest state-of-scientific-understanding of the stratospheric ozone layer. • The UNEP Synthesis Report gives the 1998 findings of all three of the Protocol's ozone depletion assessment panels (scientific, environmental effects, and technology and economics). • A summary report of the Aeronomy Laboratory's research is now available in final printed form. *The Aeronomy Laboratory Report: 1993-1998* was prepared for the AL Review held last September.



Issues of *On the Air!* may be accessed now from our Aeronomy Lab home page (www.al.noaa.gov).



AVIATION AND THE GLOBAL ATMOSPHERE: A NEW ASSESSMENT PARTNERSHIP



[Note: This is the fourth in a series of articles about the Aeronomy Lab's current participation in science assessments.]

A special report by the Intergovernmental Panel on Climate Change (IPCC), *Aviation and the Global Atmosphere*, is just off the press. It breaks new ground in more ways than one. It is the first international assessment dedicated to the issue of how aircraft emissions influence climate and the ozone layer. And two communities—scientific researchers and aviation technology specialists—collaborated for the first time to offer a multidimensional view of the topic. The result is a document that presents not only the latest scientific understanding of the atmospheric implications of aircraft, but also a technological perspective on future developments in aviation operations and aircraft engine technology that will have a bearing on the global atmosphere. The exchange of information between those two communities, science and industry, enabled a more comprehensive prediction of aviation's future impacts on Earth's atmosphere.

Motivation for the focus on aviation: aircraft usage has been increasing since the 1960s and is projected to continue to increase in the foreseeable future. Aviation impacts on climate and the ozone layer are expected to follow suit. IPCC uses a reference-case scenario in which the average growth in commercial subsonic aircraft travel is about 3% annually between 1990 and 2050. In this scenario, aircraft emissions of carbon dioxide (CO₂; a greenhouse gas) would become 3% of all human CO₂ emissions in 2050, up from their 2% contribution to the total in 1992. Other atmospheric effects of aircraft usage arise from the emission of nitrogen oxides, which are formed during the combustion of aircraft fuel. These emissions lead to an increase in tropo-

spheric ozone, a decrease in stratospheric ozone, and reduced levels of atmospheric methane. Other aviation effects arise from the impacts of contrails and from aerosol emissions. Atmospheric water vapor, which (like CO₂) is a greenhouse gas, is projected to increase, but with a lesser implication for global warming.

The bottom line: the report projects that the climate impacts of emissions from commercial subsonic aviation will nearly quadruple from 1992 to 2050 for the reference scenario. Uncertainties, analyzed extensively in the report, lead to an estimate that the future contribution of aircraft to total human-caused climate warming could range from ~3% to as much as ~14% (with the reference case yielding about 5%). The projected net effect of increased tropospheric ozone and reduced stratospheric ozone is an increase in total column ozone, resulting in about a 1% reduction in the amount of ultraviolet radiation reaching Earth's surface.

The possibility of greatly expanded commercial stratospheric air travel is also explored in the IPCC report, but the reality of such a future fleet of these high-flying supersonic aircraft is more tentative. If a proposed supersonic fleet of 1000 aircraft were indeed to materialize, the climate effects of aviation would be increased by about 40%. Because stratospheric ozone is depleted to a greater extent by supersonics, the net effect of combined supersonic and subsonic aviation is a decrease in total column ozone.

Aeronomy Lab scientist David Fahey is a Coordinating Lead Author of the report's chapter on aviation-produced aerosols and cloudiness. Dan Albritton served on the organizing and steering committees and as the liaison with the Montreal Protocol.

[The Executive Summary of the report appears on IPCC's Web site: www.ipcc.ch]

THE 1999 AIR QUALITY STUDY: A "TALE OF TWO CITIES"

Aeronomy Lab researchers and their colleagues from across the nation are converging on two southern U.S. cities this summer for a 1999 air quality field campaign associated with NOAA's Health of the Atmosphere research. The scientific "Tale of Two Cities" will play out in Nashville and Atlanta, where researchers from the Aeronomy Lab's Tropospheric Chemistry program and Theoretical Aeronomy program will join colleagues from other NOAA Labs (ETL, ARL, and CMDL), NCAR, and other institutions. The objective of the campaign is to investigate the processes responsible for the formation of oxidants and fine particulate matter (PM) in the southern U.S., and their interactions.

Why the South? Air quality issues in the southern U.S. have two characteristics: they are unlike those in other areas of the country; and they have proven to be rather immune to treatment under the air quality management strategies that currently exist. In the 1980s, research by the Aeronomy Lab and others began to reveal that these two characteristics are not unrelated. In the South, "island cities" are located amid large forested areas, and the region's summer climate profile includes warm temperatures, high humidity, intense solar insolation, and a high frequency of stagnation events. The result is an air chemistry that differs from the chemistry that was addressed by the 1970s' air quality legislation. Studies in the 1980s and 1990s have focused largely on ozone itself. National decisionmaking now includes increased attention on particulate matter (PM) pollution as well. This summer's study will feature an expanded set of measurements and strategies to investigate PM and PM-related processes.

Nashville, Tennessee, provides the first of two stages where the 1999 story will unfold. In the June 15-July 15 Nashville Field Intensive, investigators will "take to the skies" in instrumented aircraft from NOAA (the WP-3D four-engine turboprop and the NOAA deHavilland Caribou two-engine turboprop), the Department of Energy (the G-1 two-engine turboprop), and the Tennessee Valley Authority (the Bell 205 helicopter). Those aircraft measurements will be coordinated with measurements from a ground-based network of chemistry and meteorological instruments, which will include sites that are in the broad regional area as well as upwind, downwind, and "right at" the downtown Nashville source of urban pollution. Aeronomy Lab scientists are providing several of the measurements that are being made on the NOAA WP-3D aircraft, including continuous data for ozone, carbon monoxide, carbon dioxide, hydrocarbons, sulfur dioxide, hydrogen peroxide, and various nitrogen-containing compounds.

The coordinated suite of measurements has been designed to enable researchers to address three major study themes:

- *Local versus Regional Issues - Regional Contrasts.* The suite of chemical and meteorological instruments aboard the aircraft will give scientists a handle on how much of the ozone or fine particle pollution is produced locally and how much is produced remotely and then transported to a particular locale. Flights in the Upper Midwest will give researchers a sampling of another region to compare with the Nashville/Middle Tennessee area.
- *Ozone and PM Formation in Plumes.* Urban areas and also coal-fired power rural plants are situated in the study area somewhat like "raisins in a pudding" — they are pollution point sources in the midst of vast areas of forest and other vegetation. This provides an ideal setting for the study of whether ozone and/or fine particles observed in a particular location can be attributed to a particular source of precursor compounds. The interaction of power plant plumes, urban plumes, and the regional background sets up a variety of conditions that can be investigated. And the field intensive will provide a rare opportunity to do an extensive study of the co-variation of ozone and particulate matter, an issue that has not yet been addressed thoroughly on a regional scale.
- *Diurnal Cycle in Chemistry and Meteorology.* The surface-based and airborne observations will document the chemistry and meteorology over one or more complete, consecutive diurnal cycles. Nighttime processes have been little studied, but mixing processes and non-photochemical reactions that occur at night do influence the daytime processes; they also couple the chemistry of rural and urban areas.

In August, the scene will shift to Atlanta for the second portion of the 1999 field campaign. Work in that city will focus on characterizing the performance of existing and newly developed techniques for measuring particulate matter; intercomparing the accuracy and consistency of those various PM measurements; and evaluating the scientific information that can be obtained from various approaches to measuring chemical, physical, and health-related attributes of PM at multiple sampling sites. The Aeronomy Lab's particle analysis by laser mass spectrometry (PALMS) instrument is playing a key role in Atlanta by providing a chemical characterization of individual particles.

And so the drama unfolds in this summer's tropospheric "Tale of Two Cities," where scientists are the key players on the dual-city stage. In the audience are air quality decisionmakers, who are watching for an improved understanding of air quality issues in the southern U.S.

[The progress of the 1999 field campaign is chronicled on the Aeronomy Lab's home page: www.al.noaa.gov.]



HOME and AWAY

A New "Profile" for the AL Wind Profiling Radars

The Aeronomy Lab's wind profiling radar station at Christmas Island in the tropical Pacific was put to a novel use in March, when it provided critical meteorological data that enabled the first launch of a rocket from the "Sea Launch" platform. Sea Launch is a private sector venture to place commercial telecommunications satellites into orbit. With land-based launching facilities heavily oversubscribed and hundreds of satellites slated for launch in the coming years, Sea Launch partners Boeing Commercial Space

Company (U.S.) and international partners in Russia, Ukraine, and Norway are developing a "launch at sea" approach as a cost-effective alternative for the commercial sector. Equatorial sites are optimal for launches, because the earth's rotational speed is greatest and the rocket gets an extra "boost" as it heads for space.

The opportunity for NOAA's involvement came as the Sea Launch partners prepared for their first test launch. The Sea Launch platform (a former North Sea oil drilling platform) was loaded with its rocket payload in California and then moved to the equatorial Pacific Ocean 200 miles east of Christmas Island. The Aeronomy Lab's Tropical Dynamics

and Climate group operates two wind profilers on Christmas Island that provide wind information over the tropical oceans to improve understanding of the variability of atmospheric circulation associated with El Niño/La Niña events. Wind profilers are Doppler radars that observe winds by measuring the Doppler shift of echoes from atmospheric turbulent irregularities. Since 1986, profilers at Christmas Island have provided unique observations of winds throughout most of the lower atmosphere in a geographical region where few atmospheric observations exist. The long-term data record from the NOAA profilers had, in fact, been used by the Sea Launch partners to determine the environmental wind conditions through which Sea Launch rockets would fly.

Sea Launch balloon soundings indicated that there was an exceptional wind shear three days prior to the scheduled launch. With the time-critical countdown proceeding, they needed confirmation of their balloon soundings and further detail about the meteorology that the soundings could not provide. The Aeronomy Lab's wind profiler data were uniquely suited, providing the increased frequency of observations that was needed. Warner Ecklund, Paul Johnston, Dave Carter, and Barbara Herrli were involved in efforts to provide Sea Launch with near-real time access to the critical information from the profilers. The data showed that the wind shear had abated such that the launch could proceed.

Already a key contributor to NOAA/OAR research on tropical dynamics and climate, the wind profilers proved to be an invaluable resource in a new arena. Ken Gage, head of the Aeronomy Laboratory's Pacific wind profiling efforts, foresees further interactions with the private sector Sea Launch efforts. ♣

ACCENT on Emissions

Members of the Meteorological Chemistry group are pursuing a better understanding of rocket and aircraft emissions in their participation in the NASA-sponsored Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT) field experiments. Phase 1 of the mission took place in April/May, when AL researchers used the Houston-based NASA WB-57F aircraft to make measurements of ozone, water, pressure, temperature, and winds. ACCENT resumes this August and September with another series of flights, when the Aeronomy Lab will add two more instruments to the payload: the particle analysis by laser mass spectrometry (PALMS) instrument, and a new chemical ionization mass spectrometry instrument for measuring nitric acid (HNO₃). Watch our next issue for more details. ♣



WHAT'S UP WITH PEOPLE

After over 40 years with the Aeronomy Lab, **Tom Van Zandt** retired from federal employment. He will continue his research on atmospheric dynamics under "Emeritus" status at the Lab... In the Tropospheric Chemistry group: **Karl Knapp**, of Western State College, is a visiting researcher with the group for the summer. **Shanhu Li** and **Rebecca Washenfelder** have joined the group and will be doing research on the chemical composition of atmospheric aerosols. Shanhu was formerly a postdoc in Mario Molina's group at MIT. Rebecca recently received her B.S. in chemistry from Pomona College in California. **Greg Huey** has left the group to take a position at the Georgia Institute of Technology, where he will continue his research on chemical ionization mass spectrometry methods for the measurement of atmospheric trace gases... **Gerhard Wotawa** is visiting the Theoretical Aeronomy group for one

Ryan Sanders

A tragic plane crash claimed the life of Ryan Sanders on May 3, 1999. Ryan was traveling to California with friend Glenn Davis and acquaintance Robert Jones when the accident occurred in Utah. All three were killed.

Ryan was known throughout the world as an impeccable researcher. He had been a key member of the Aeronomy Lab's Middle Atmosphere group since 1985, where he made groundbreaking measurements in Antarctica that helped determine the cause of the ozone hole. He had many interests, a zestful and adventurous approach to life, and a seemingly perpetual sparkle in his eyes. Maria Neary, his wife and a close colleague of many at the Aeronomy Lab, will establish a memorial bench in his honor on the Skaggs Building grounds, near the Aeronomy Laboratory.

Greatly Admired • Greatly Missed

year, doing modeling research on pollutant transport. He is from the University of Vienna Agricultural Sciences...

Andy Langford has moved to the Middle Atmosphere group. He will be conducting and analyzing atmospheric spectroscopic measurements... **Guus Velders**, of the National Institute of Public Health and the Environment (RIVM) in the Netherlands, will come to the Aeronomy Lab for a 7-month visit beginning in July. He will be working with members of the Middle Atmosphere group... **John Pyle**, of the UK's University of Cambridge, will be visiting the Aeronomy Lab this summer to work with several AL scientists... **Dave Hanson** has begun a new position in the Atmospheric Chemistry Division at NCAR. He had worked for several years in the Atmospheric Chemical Kinetics group. **Gary Knight** has started with ACK as a postdoc. He was most recently a postdoc at the Max Planck Institute in Mainz. **Linda Koch**, a graduate student at CU, has joined the group also. **Tomasz Gierczak**, of the University of Warsaw, will be with ACK for a summer postdoctoral position... **Tim Bertram** of Colby College is working with the Meteorological Chemistry group as a summer student. His internship is through the NOAA Practical Hands-On Application of Science Education (PHASE) program. **Megan Melamed**, who worked with AL last summer as a PHASE student, will be returning for July and August to carry out research in the Middle Atmosphere program.

We wish everyone the best in their new endeavors, whether here or elsewhere!

COMMUNICATING OUR SCIENCE



To Decisionmakers: Dan Albritton presented briefings about Health of the Atmosphere air quality research to visiting Congressional staffers on February 17, and he traveled to Capitol Hill to brief Congressional members in March. That same month, he also met with the agency representatives of the Committee on Environment and Natural Resources (CENR) to describe the particulate matter (PM) issue, especially with regard to the integration of atmospheric science research and health effects research on that topic... Dan Albritton and Dave Fahey attended the final plenary session of the IPCC aviation special report, held in Costa Rica in April... Dan Albritton served as science advisor at the Montreal Protocol Working Group Meeting, held June 15-18 in Geneva. Dan described the ozone-layer assessment report of the Protocol's science panel and the IPCC aviation special report (see related story, p. 1).

To the Scientific Community: Venues included:

- **Scientific Conferences and Symposia:** Bob Portmann gave an invited talk at the First International Workshop on Long Term Changes and Trends in the Atmosphere (LT-

ACT99) in Pune, India in February... In February, Stu McKeen gave a talk at the Department of Energy Atmospheric Chemistry Program Annual Science Meeting on the topic of boundary layer transport... Ken Gage, Christopher Williams, and Tom Van Zandt gave talks about wind profiler research at the Progress in Electromagnetics Research Symposium (PIERS 99) held in Taiwan in March. Ken was one of the Program organizers... Claire Granier presented a paper on the effect of human-made emissions on the stratosphere at the meeting of the European Geophysical Society, held at The Hague, Netherlands, in April... David Fahey and David Thomson participated in the 1999 Atmospheric Effects of Aviation Project (AEAP) conference in Virginia Beach in April... Ravi gave an invited talk at the annual meeting of the German Physical Chemistry Society in May... Several Aeronomy Lab scientists gave presentations and posters at the Spring Meeting of the American Geophysical Union, held June 1-4 in Boston. The meeting included a special two-day program honoring JPL's Bill DeMore for his research in atmospheric chemical kinetics and data evaluation. Ravi organized the program and Carl Howard chaired one of its four sessions... Several Aeronomy Lab scientists participated in the June 14-17 Gordon Research Conference on Atmospheric Chemistry, held in West Kingston, RI.

- **Research Workshops:** Dave Fahey and Karen Rosenlof participated in the Panel on Atmospheric Effects of Aviation (PAEAN) Meeting in Irvine in February... Fred Fehsenfeld and Dave Thomson attended the Southern Oxidants Study Supersite Planning Workshop at Georgia Tech in February... Jim Meagher gave a presentation at the Electric Power and Research Institute Supersite Workshop in March... Jim Meagher and Victor Dvortsov attended a Southern Oxidants Study modeling workshop held at Research Triangle Park in early April... In May, George Kiladis was an invited participant in the Pacific Implementation Panel meeting of the National Science Foundation's Climate Variability and Predictability (CLIVAR) study... Karen Rosenlof and Ken Kelly participated in the Stratospheric Processes and Their Role in Climate (SPARC) Water Vapor Assessment meeting in Fairfax, Virginia, on June 7-9.

- **Invited Lectures and Seminars:** David Fahey gave an invited seminar about the Photochemistry of Ozone Loss in the Arctic Region In Summer (POLARIS) mission at the University of Wisconsin Department of Atmospheric and Oceanic Services in March... Ravi gave an invited presentation at the University of Warsaw in May... Christopher Williams went to NASA-Goddard in May to describe the profiler observations from the TEFLUN A/B missions to scientists of the Tropical Rainfall Measuring Mission (TRMM)... George Kiladis spoke about equatorial waves at the Department of Meteorology, McGill University, in May.

To Constituents: Dan Albritton participated in a February constituents workshop for NOAA's information "customers."

To the Public: Leslie Hartten prepared a display for the Limon Heritage Museum (Limon, Colorado) on the topic of "El Niño, La Niña, and Limon." It will be on display for the Museum's summer season... Susan Solomon spoke on ozone depletion at the annual PLAN Boulder County meeting in February.

To Students and Teachers: Wally Clark and his wife were judges at the Odyssey of the Mind contest for K-12 students, held on May 10 in Greeley... Sandra Laursen has coauthored a student manual for use in introductory chemistry courses... Ned Lovejoy hosted a junior high student's visit to the Aeronomy Lab on Career Day in April... Dave Fahey discussed stratospheric ozone with two classes of earth science students at Edgewood High School (Madison, Wisconsin) in March... Sandra Laursen served as a judge at the Boulder Valley Regional Science Fair on

March 5... Dan Albritton spoke to CU students in March about the interactions of science and policy on global environmental change... Donna Sueper was a judge at the science fair at Horizons Charter School in February... Paul Goldan gave a special demonstration on atmospheric chemistry to 5th and 6th graders at Emerald School in Broomfield in February... Dan Hereid gave a talk on global warming to 6th graders at John Dewey Middle School in Denver... Ryan Sanders gave presentations on Antarctica to kindergarten classes at High Peaks Elementary School in January, and also was a judge at the school's science fair that same month.

To Our Visitors: Ken Gage hosted the March visit of Uday Joshi, of the NOAA/OAR International Activities staff... A visit of the staff that administers NOAA's National Research Council postdoctoral program took place in May. Stephen Reid, Steve Brown, Sandra Laursen (the Lab's current NRC associates and postdocs) and Chris Ennis participated in presentations to the group.

Through Service on Scientific Panels and Boards: Ravi has accepted a three-year term as editor of *Geophysical Research Letters* (atmospheric chemistry)... Susan Solomon and Dan Murphy are chapter authors, and Dan Albritton is leading the drafting of the assessment technical summary of the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report... Susan Solomon is a member of the Joint Scientific Committee of the World Climate Research Programme (WCRP), which met in Germany in March.

DOWN THE ROAD



June 23-24: International Symposium on Aviation and the Global Atmosphere, The Netherlands. Dave Fahey is on the organizing committee and is a participant. Introduction of the IPCC Special Report will take place (see page 1 story).

June/July: NAURU99 field study, on the island of Nauru in the tropical Pacific. Members of the Tropical Dynamics and Climate group have radar profilers on the island and on the NOAA Research Vessel *Ronald H. Brown* in this phase of the DOE Atmospheric Radiation Measurement study.

July 12-16: The 29th International Conference on Radar Meteorology, Montreal. Several members of the Tropical Dynamics and Climate group will make presentations.

July 19-30: International Union of Geodesy and Geophysics 99, Birmingham, UK. AL scientists in several groups will give talks, and Ravi will be co-convenor of two sessions.

August-September: KWAJEX campaign, Marshall Islands-Kwajalein atoll. The Tropical Dynamics and Climate group is participating in this phase of the Tropical Rainfall Measuring Mission field study.

September 1-3: Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report, second draft meeting, Tanzania. AL scientists are among the authors of the report.

September 13-17: Sixth Scientific Conference of the International Global Atmospheric Chemistry Project (IGAC), Bologna, Italy. Members of the Tropospheric Chemistry program will attend.

On the Air! is a quarterly publication of the NOAA Aeronomy Laboratory. It is posted on the World Wide Web at www.al.noaa.gov. Please send comments, suggestions, or questions to: Chris Ennis (phone 303-497-7538; email Christine.A.Ennis@noaa.gov).

